

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-216591

(43)Date of publication of application : 10.08.1999

(51)Int.Cl.

B23K 35/26  
// C22C 13/00

(21)Application number : 10-016142

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(22)Date of filing : 28.01.1998

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## (54) SOLDERING PRODUCT

### (57)Abstract:

PROBLEM TO BE SOLVED: To prevent the electrode consuming and characteristic deterioration when soldering or thermal aging after soldering is carried out.

SOLUTION: A part having a transition metal conductor, which is easy to be dispersed, is jointed to molten Sn by the solder to form a soldering product. The solder contains at least one kind of 0.01-1 wt.% Co, 0.0 0.2 wt.% Fe, 0.01-0.2 wt.% Mn, 0.01-0.2 wt.% Cr, 0.01-2 wt.% Pd, at least one kind of 0.5-9 wt.% Ag, 0.5 wt.% Cu, 0.5-5 wt.% Sb, and the balance of Sn.

## LEGAL STATUS

[Date of request for examination] 26.06.2001

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the  
examiner's decision of rejection or application  
converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of  
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CLAIMS

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[Claim(s)]

[Claim 1] They are the soldering goods which come to join the parts which have the changes metallic conductor which is easy to diffuse to fused Sn with solder. composition of the aforementioned solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), soldering goods that contain at least one kind and the remaining Sn among 0.5 - 5 % of the weight of Sb(s), and are characterized by the bird clapper.

[Claim 2] The aforementioned changes metallic conductors are soldering goods according to claim 1 characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, Pt, and Zn, or those alloys.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to soldering goods.

[0002]

[Description of the Prior Art] Before, solder is used in order to obtain electric and mechanical connection of electron equipment and electronic parts. The solder (it considers as Pb free solder hereafter.) with which this solder makes a principal component Sn which does not contain Pb in consideration of earth environment although what made Sn an Pb the principal component (it considers as Sn-Pb system solder below.) has generally been used, and the remainder consists of Ag, Bi, Cu, In, Sb, etc. is used increasingly.

[0003] By using this Pb free solder in recent years, the soldering goods with which soldering nature has a good elect joint have been manufactured.

[0004]

[Problem(s) to be Solved by the Invention] However, in the soldering goods using the solder whose Sn is a principal component, especially Pb free solder, when electrode \*\*\*\*\* happened at the time of soldering or elevated-temperat neglect and heat aging were performed, there was a trouble by diffusion of Sn that degradation of electric and a mechanical property took place.

[0005] The purpose of this invention is to offer the soldering goods which neither electrode \*\*\*\*\* nor property degradation can produce easily, when the time of soldering or soldering post heating aging is performed.

[0006]

[Means for Solving the Problem] this invention came to complete soldering goods, in order to solve the above-mentioned technical problem. The soldering goods of invention of this application 1st are soldering goods which com to join with solder the parts which have the changes metallic conductor which is easy to diffuse to Sn which carried o melting. composition of the aforementioned solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, At least one kind and the remaining Sn are contained among 0.5 - 9 % of the weight of Ag, 0.5 - 2 % o the weight of Cu(s), and 0.5 - 5 % of the weight of Sb(s), and it is characterized by the bird clapper.

[0007] moreover, the soldering goods of invention of this application 2nd -- setting -- the aforementioned transition metals -- a conductor is characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, P and Zn, or those alloys

[0008]

[Embodiments of the Invention] The gestalt of operation of this invention is explained below. The soldering goods o this invention are soldering goods which come to join with solder the parts which have the changes metallic conduct which is easy to diffuse to Sn which carried out melting. Composition of solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, It is the composition which contains at least one kind and the remaining Sn among 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), and 0.5 - 5 % of the weight of Sb(s). Such composition enables it to offer the soldering goods which have sufficient electrode-proof \*\*\*\*\*\*, while soldering nature and a bonding strength are good.

[0009] That is, it is for Co, Fe, Mn, Cr, and Pd by which slight amount addition was carried out to form a segregation layer in the junction interface of a conductor and solder, to prevent diffusion into the melting solder of a conductor, a to prevent electrode \*\*\*\*\*.

[0010] The addition of Above Co was made into 0.01 - 1 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Co is less than 0.01 % of the weight. It is because liquid line temperature rises and a melting property is checked on the other hand, when the addition of Co exceeds 1 % of the weight. In addition, more desirable Co addition is 0.01 - 0.5% of the weight of a range, and its time of especially Co addition being 0.5 % of the weight is desirable.

[0011] The addition of Above Fe was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Fe is less than 0.01 % of the weight. It is because liquidus line temperature rises and a melting property is checked on the other hand, when the addition of Fe exceeds 0.2 % of the weight. In addition, more desirable Fe addition is 0.01 - 0.1% of the weight of a range, and its time of especially addition being 0.1 % of the weight is desirable.

[0012] The addition of Above Mn was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Mn is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Mn exceeds 0.2 % of the weight. In addition, more desirable Mn addition is 0.01 - 0.1% of the weight of a range, and its time of especially Mn addition being 0.1 % of the weight is desirable.

[0013] The addition of Above Cr was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole weights because electrode-proof \*\*\*\*\* deteriorated when the addition of Cr is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Cr exceeds 0.2 % of the weight. In addition, more desirable Cr addition is 0.01 - 0.1% of the weight of a range, and its time of especially Cr addition being 0.1 % of the weight is desirable.

[0014] The addition of Above Pd was made into 0.01 - 2 % of the weight in 100 % of the weight of whole weights because electrode-proof \*\*\*\*\* deteriorated when the addition of Pd is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Pd exceeds % of the weight. In addition, more desirable Pd addition is 0.01 - 1% of the weight of a range, and its time of especia Pd addition being 0.5 % of the weight is desirable.

[0015] The addition of Above Ag was carried out among [ 0.5-9 ] 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Ag is less than 0.5 % of the weight. It is because the bonding-strength fall by a superfluous Ag<sub>3</sub>Sn intermetallic compound depositing and the melting property by solder liquidus-line temperature rising are checked on the other hand when the addition of Ag exceeds 9 % of the weight.

[0016] The addition of Above Cu was made into 0.5 - 2 % of the weight in 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Cu is less than 0.5 % of the weight. It is because the bonding-strength fall by superfluous Cu<sub>6</sub>Sn<sub>5</sub> and a Cu<sub>3</sub>Sn intermetallic compound depositing and the melting property by solder liquidus-line temperature rising are checked on the other hand when the addition of Cu exceeds 2 % of the weight.

[0017] The addition of Above Sb was made into 0.5 - 12 % of the weight in 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Sb is less than 0.5 % of the weight. It is because thermal shock nature and processability are checked on the other hand when elongation falls, when the addition of Sb exceeds 12 % of the weight.

[0018] the transition metals which are easy to diffuse to fused Sn as used in the field of this invention -- as composit of a conductor, the simple substance of Cu, Ag, nickel, Au, Pd, Pt, and Zn etc. is typical In addition, the alloy of thes transition metals, for example, Ag/Pd, Ag/Pt, etc. are sufficient. They are the simple substance of Cu, Ag, and nickel its alloy more preferably. Electrode \*\*\*\*\* suppression is attained maintaining soldering nature and a bonding strength, even if it uses for the goods which have such a conductor that is easy to carry out electrode \*\*\*\*\*.

[0019] Although a glass frit and various additives (metallic oxide etc.) are added by the above-mentioned changes metallic conductor if needed, if the metal composition which is electric conduction components is the above composition, of course, the same effect is acquired. Moreover, the same effect is acquired when low melting point metals, such as Bi and In, are added as solder composition in order to lower a working temperature.

[0020] Here, in this invention, an unescapable impurity may be included as solder composition in addition to the abo mentioned component. The element mixed as an unescapable impurity when manufacturing solder or the element containing from the first, for example, Pb, Bi, Cu, Na, etc., is mentioned.

[0021] After the soldering goods of this invention process the solder made to dissolve the above-mentioned addition

component in Sn of a principal component in the shape of a ball, carry a solder ball on parts or a substrate and apply flux, they can be easily created by heating to temperature predetermined in the inside of the atmosphere, and joining conductor of parts.

[0022] In addition, although generally soldered in many cases in N<sub>2</sub> atmosphere a sake [ on a soldering disposition ] is possible to solder in the atmosphere in this invention, since there are few additions of Co, Fe, Mn, Cr, and Pd.

[0023] the parts itself to which the soldering goods of this invention are joined, and the conductor of parts, although whole including the soldered joint section which joined comrades electrically and mechanically is meant and there ar various gestalten For example, electric in the conductor formed in the element-placement substrate, and the conducto formed in parts The thing made to solder in order to make it connect mechanically, the thing which carried out the solder price in order to connect an electronic-parts element and a terminal electrically and mechanically, the thing m to solder in order to connect the electrodes of an electronic-parts element electrically and mechanically are typical.

[0024] As the above-mentioned element-placement substrate, ceramic substrates, such as a printed circuit board mad from glass epoxy, a printed circuit board made from a phenol, and an alumina, the substrate which has insulator laye such as a ceramic, on a metaled front face are mentioned, for example. furthermore, the above -- as a conductor, wiri circuits, such as a printed circuit board, the terminal electrode of electronic parts, a lead terminal, etc. are mentioned

[0025] Thus, the soldering goods of the produced this invention have soldering nature and a good bonding strength, since they have outstanding electrode-proof \*\*\*\*\*\*, can set up soldering temperature freely and become the thing excellent in workability. Moreover, it becomes possible to lessen the addition of expensive electrode \*\*\*\*\* suppression elements, such as Ag. Next, although this invention is explained still more concretely based on an exam this invention is not limited only to this example.

[0026]

[Example 1] The solder composition used by this example is shown in Table 1. In addition, composition of the exam of comparison is also collectively shown in Table 1.

[0027]

[Table 1]

	[重量%]	Sn	Pb	Co	Fe	Mn	C	Pd	Ag	Cu	Sb
実施例1	94.99			0.01							5.0
実施例2	94.5			0.5							5.0
実施例3	94.0			1.0							5.0
実施例4	94.49			0.01							5.0
実施例5	94.9			0.1							5.0
実施例6	94.8			0.2							5.0
実施例7	94.49			0.01							5.0
実施例8	94.9			0.1							5.0
実施例9	94.9			0.2							5.0
実施例10	94.49			0.01							5.0
実施例11	94.9			0.1							5.0
実施例12	94.8			0.2							5.0
実施例13	94.99			0.01							5.0
実施例14	94.5			0.5							5.0
実施例15	94.0			1.0							5.0
実施例16	93.0										5.0
実施例17	99.0										0.5
実施例18	87.5										12.0
実施例19	96.0			0.5							
実施例20	96.4			0.1							
実施例21	96.4			0.1							
実施例22	96.4			0.1							
実施例23	99.0										
実施例24	96.0										
実施例25	90.5										
実施例26	98.8			0.5							
実施例27	99.2			0.1							
実施例28	99.2			0.1							
実施例29	99.2										
実施例30	98.8										
実施例31	99.0										
実施例32	97.5										
比較例1	96.0										5.0
比較例2	96.5										
比較例3	99.3										

[0028] About the solder furthermore shown in Table 1, the evaluation result of electrode-proof \*\*\*\*\* at the time soldering and soldering nature is shown in Table 2.

[0029]

[Table 2]

	半田付け後の電極面積残存率[%]		半田広がり率[%]	評価温度[°C]
	Cu電極	Ag電極		
実施例1	85.0	50.0	70	280
実施例2	98.0	60.0	71	280
実施例3	99.6	61.2	65	280
実施例4	77.0	38.0	70	280
実施例5	80.0	40.2	69	280
実施例6	81.0	41.0	63	280
実施例7	99.0	74.2	70	280
実施例8	99.5	80.1	66	280
実施例9	99.4	79.2	60	280
実施例10	86.0	60.2	70	280
実施例11	98.4	63.0	67	280
実施例12	99.0	65.3	62	280
実施例13	82.1	51.6	71	280
実施例14	95.4	63.5	70	280
実施例15	96.3	65.4	69	280
実施例16	97.1	67.8	63	280
実施例17	95.9	53.4	72	280
実施例18	84.1	51.8	78	300
実施例19	99.0	81.0	72	250
実施例20	95.4	76.8	69	250
実施例21	99.2	89.7	64	250
実施例22	99.2	85.0	66	250
実施例23	88.7	79.3	72	260
実施例24	99.7	84.6	72	250
実施例25	99.5	88.1	81	330
実施例26	99.7	52.0	71	260
実施例27	97.0	40.8	69	260
実施例28	99.5	68.9	65	260
実施例29	99.8	58.4	66	260
実施例30	99.6	53.2	72	260
実施例31	99.2	52.3	72	260
実施例32	99.5	50.1	78	330
比較例1	89.2	31.7	72	250
比較例2	7.0	0.0	70	280
比較例3	92.5	0.0	71	260

[0030] Here, the electrode-proof \*\*\*\*\* evaluation at the time of soldering measured by the electrostatic-capacity changing method. the veneer capacitor which carried out printing baking of Cu electrode (3 micrometers of thickness or the Ag electrode (20 micrometers of thickness) -- solder -- being immersed -- the difference of the electrostatic capacity before and behind being immersed -- the above to as opposed to [ take a value and ] the electrostatic capacit before being immersed -- difference -- the survival rate of an electrode was computed in quest of the value The soldering temperature which evaluated is shown in Table 2. For 10 seconds, since the capacity change after being immersed and Ag electrode were easy to be consumed, Cu electrode measured the capacity change after being immersed for 3 seconds.

[0031] In any case, in Cu electrode, the effect was [ the alloying element of this invention ] in electrode foods crack suppression as compared with the example of comparison. An electrode survival rate is 95% or more, and examples 3, examples 7-9, examples 11-12, examples 14-17, examples 19-22, and examples 24-32 showed electrode-proof \*\*\*\*\* with very good all. Moreover, in the examples 1-2 of comparison which are typical Pb free solder, an electrode survival rate is 90% or less, and the problem was looked at by electrode-proof \*\*\*\*\*.

[0032] Although examples 1, 4, 10, and 13 are 77 - 86% of electrode survival rates and are smaller than other examples, this is because there are few additions of an effective element. [ of electrode \*\*\*\*\* depressor effect ] Moreover, although an example 18 also has electrode \*\*\*\*\* depressor effect smaller than other examples, this is because soldering temperature is high. Moreover, although examples 5-6 also have the electrode-proof \*\*\*\*\* effec smaller than other examples, this is because the electrode \*\*\*\*\* depressor effect of Fe is smaller than other elemen

However, any composition is level usable according to soldering conditions.

[0033] Moreover, there were Cu and an analogous inclination also in Ag electrode, and when it was any, as compare with the example of comparison, the alloying element of this invention had an effect in electrode foods crack suppression.

[0034] About soldering nature, it evaluated using the rate of a solder breadth (based on JISZ3197). About examples 1 2, an example 4, an example 7, an example 10, examples 13-14, examples 17-19, examples 23-26, and examples 30- the rate of a solder breadth was all 70% or more, and it was very good soldering nature. Moreover, also about the examples 1-3 of comparison, the rate of a solder breadth was all 70% or more, and it was very good soldering nature

[0035] Although the rate of a solder breadth is falling, this of an example 3, an example 6, an example 9, an example 12, and examples 15-16 is because liquid phase temperature rose since there were many additions of an effective element, and the fluidity of solder was checked. Moreover, although examples 8-9, examples 11-12, examples 21-22 and examples 28-29 show the rate of a low solder breadth from other examples, this is for an effective element (Mn, Cr) to tend to oxidize. However, any composition is level usable according to soldering conditions.

[0036] Moreover, although the rate of a solder breadth is high if the addition of Sb, Ag, and Cu is increased as shown an example 18, an example 25, and an example 32, the influence which raised soldering temperature with elevation o liquid phase temperature comes out of this.

[0037]

[Effect of the Invention] Thus, if the soldering goods of this invention are used, while soldering nature is good in the soldered joint section, it is possible to have outstanding electrode-proof \*\*\*\*\*. Moreover, this electrode-proof \*\*\*\*\* cannot remain in electrode \*\*\*\*\* at the time of soldering, but can be suppressed also about electrode \*\*\*\*\* at the time of elevated-temperature neglect of the soldering goods after soldering.

[0038] Moreover, since electrode \*\*\*\*\* which has been a technical problem with Pb free solder can be suppressed, free-ization of solder becomes more practical and it becomes possible to offer an eco-friendly product.

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TECHNICAL FIELD

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PRIOR ART

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[Description of the Prior Art] Before, solder is used in order to obtain electric and mechanical connection of electron equipment and electronic parts. The solder (it considers as Pb free solder hereafter.) with which this solder makes a principal component Sn which does not contain Pb in consideration of earth environment although what made Sn an Pb the principal component (it considers as Sn-Pb system solder below.) has generally been used, and the remainder consists of Ag, Bi, Cu, In, Sb, etc. is used increasingly.

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## EFFECT OF THE INVENTION

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[Effect of the Invention] Thus, if the soldering goods of this invention are used, while soldering nature is good in the soldered joint section, it is possible to have outstanding electrode-proof \*\*\*\*\*. Moreover, this electrode-proof \*\*\*\*\* cannot remain in electrode \*\*\*\*\* at the time of soldering, but can be suppressed also about electrode \*\*\*\*\* at the time of elevated-temperature neglect of the soldering goods after soldering.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, in the soldering goods using the solder whose Sn is a principal component, especially Pb free solder, when electrode \*\*\*\*\* happened at the time of soldering or elevated-temperature neglect and heat aging were performed, there was a trouble by diffusion of Sn that degradation of electric and a mechanical property took place.

[0005] The purpose of this invention is to offer the soldering goods which neither electrode \*\*\*\*\* nor property degradation can produce easily, when the time of soldering or soldering post heating aging is performed.

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MEANS

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[Means for Solving the Problem] this invention came to complete soldering goods, in order to solve the above-mentioned technical problem. The soldering goods of invention of this application 1st are soldering goods which come to join with solder the parts which have the changes metallic conductor which is easy to diffuse to Sn which carried out melting. composition of the aforementioned solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, At least one kind and the remaining Sn are contained among 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), and 0.5 - 5 % of the weight of Sb(s), and it is characterized by the bird clapper.

[0007] moreover, the soldering goods of invention of this application 2nd -- setting -- the aforementioned transition metals -- a conductor is characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, P and Zn, or those alloys

[0008]

[Embodiments of the Invention] The form of operation of this invention is explained below. The soldering goods of invention are soldering goods which come to join with solder the parts which have the changes metallic conductor which is easy to diffuse to Sn which carried out melting. Composition of solder At least one kind of 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, It is the composition which contains at least one kind and the remaining Sn among 0.5 - 9 % of the weight of Ag, 0.5 - 2 % of the weight of Cu(s), and 0.5 - 5 % of the weight of Sb(s). Such composition enables it to offer the soldering goods which have sufficient electrode-proof \*\*\*\*\*\*, while soldering nature and a bonding strength are good.

[0009] That is, it is for Co, Fe, Mn, Cr, and Pd by which slight amount addition was carried out to form a segregation layer in the junction interface of a conductor and solder, to prevent diffusion into the melting solder of a conductor, a to prevent electrode \*\*\*\*\*.

[0010] The addition of Above Co was made into 0.01 - 1 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Co is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Co exceeds 1 % of the weight. In addition, more desirable Co addition is 0.01 - 0.5% of the weight of a range, and its time of especially Co addition being 0.5 % of the weight is desirable.

[0011] The addition of Above Fe was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Fe is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Fe exceeds 0.2 % of the weight. In addition, more desirable Fe addition is 0.01 - 0.1% of the weight of a range, and its time of especially addition being 0.1 % of the weight is desirable.

[0012] The addition of Above Mn was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Mn is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Mn exceeds 0.2 % of the weight. In addition, more desirable Mn addition is 0.01 - 0.1% of the weight of a range, and its time of especially Mn addition being 0.1 % of the weight is desirable.

[0013] The addition of Above Cr was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole weights because electrode-proof \*\*\*\*\* deteriorated when the addition of Cr is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Cr exceeds 0.2 % of the weight. In addition, more desirable Cr addition is 0.01 - 0.1% of the weight of a range, and its time of

especially Cr addition being 0.1 % of the weight is desirable.

[0014] The addition of Above Pd was made into 0.01 - 2 % of the weight in 100 % of the weight of whole weights because electrode-proof \*\*\*\*\* deteriorated when the addition of Pd is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Pd exceeds % of the weight. In addition, more desirable Pd addition is 0.01 - 1% of the weight of a range, and its time of especia Pd addition being 0.5 % of the weight is desirable.

[0015] The addition of Above Ag was carried out among [ 0.5-9 ] 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Ag is less than 0.5 % of the weight. It is because the bonding-strength fall by a superfluous Ag<sub>3</sub>Sn intermetallic compound depositing and the melting property by solder liquidus-line temperature rising are checked on the other hand when the addition of Ag exceeds 9 % of the weight.

[0016] The addition of Above Cu was made into 0.5 - 2 % of the weight in 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Cu is less than 0.5 % of the weight. It is because the bonding-strength fall by superfluous Cu<sub>6</sub>Sn<sub>5</sub> and a Cu<sub>3</sub>Sn intermetallic compound depositing and the melting property by solder liquidus-line temperature rising are checked on the other hand when the addition of Cu exceeds 2 % of the weight.

[0017] The addition of Above Sb was made into 0.5 - 12 % of the weight in 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Sb is less than 0.5 % of the weight. It is because thermal shock nature and processability are checked on the other hand when elongation falls, when the addition of Sb exceeds 12 % of the weight.

[0018] the transition metals which are easy to diffuse to fused Sn as used in the field of this invention -- as composit of a conductor, the simple substance of Cu, Ag, nickel, Au, Pd, Pt, and Zn etc. is typical In addition, the alloy of thes transition metals, for example, Ag/Pd, Ag/Pt, etc. are sufficient. They are the simple substance of Cu, Ag, and nickel its alloy more preferably. Electrode \*\*\*\*\* suppression is attained maintaining soldering nature and a bonding strength, even if it uses for the goods which have such a conductor that is easy to carry out electrode \*\*\*\*\*.

[0019] Although a glass frit and various additives (metallic oxide etc.) are added by the above-mentioned changes metallic conductor if needed, if the metal composition which is electric conduction components is the above composition, of course, the same effect is acquired. Moreover, the same effect is acquired when low melting point metals, such as Bi and In, are added as solder composition in order to lower a working temperature.

[0020] Here, in this invention, an unescapable impurity may be included as solder composition in addition to the abo mentioned component. The element mixed as an unescapable impurity when manufacturing solder or the element containing from the first, for example, Pb, Bi, Cu, Na, etc., is mentioned.

[0021] After the soldering goods of this invention process the solder made to dissolve the above-mentioned addition component in Sn of a principal component in the shape of a ball, carry a solder ball on parts or a substrate and apply flux, they can be easily created by heating to temperature predetermined in the inside of the atmosphere, and joining conductor of parts.

[0022] In addition, although generally soldered in many cases in N<sub>2</sub> atmosphere a sake [ on a soldering disposition ] is possible to solder in the atmosphere in this invention, since there are few additions of Co, Fe, Mn, Cr, and Pd.

[0023] the parts itself to which the soldering goods of this invention are joined, and the conductor of parts, although whole including the soldered joint section which joined comrades electrically and mechanically is meant and there ar various forms For example, electric in the conductor formed in the element-placement substrate, and the conductor formed in parts The thing made to solder in order to make it connect mechanically, the thing which carried out the solder price in order to connect an electronic-parts element and a terminal electrically and mechanically, the thing m to solder in order to connect the electrodes of an electronic-parts element electrically and mechanically are typical.

[0024] As the above-mentioned element-placement substrate, ceramic substrates, such as a printed circuit board mad from glass epoxy, a printed circuit board made from a phenol, and an alumina, the substrate which has insulator laye such as a ceramic, on a metaled front face are mentioned, for example. furthermore, the above -- as a conductor, wiri circuits, such as a printed circuit board, the terminal electrode of electronic parts, a lead terminal, etc. are mentioned

[0025] Thus, the soldering goods of the produced this invention have soldering nature and a good bonding strength, since they have outstanding electrode-proof \*\*\*\*\* , can set up soldering temperature freely and become the thing excellent in workability. Moreover, it becomes possible to lessen the addition of expensive electrode \*\*\*\*\* suppression elements, such as Ag. Next, although this invention is explained still more concretely based on an exam

this invention is not limited only to this example.

[0026]

[Example 1] The solder composition used by this example is shown in Table 1. In addition, composition of the exam of comparison is also collectively shown in Table 1.

[0027]

[Table 1]

	Sn	Pb	Cs	Fe	Mn	C	Pd	Ag	Cu	Sb	■%
実施例1	94.99		0.01							5.0	
実施例2	94.5		0.5							5.0	
実施例3	94.0		1.0							5.0	
実施例4	94.49			0.01						5.0	
実施例5	94.9			0.1						5.0	
実施例6	94.8			0.2						5.0	
実施例7	94.49				0.01					5.0	
実施例8	94.9				0.1					5.0	
実施例9	94.8				0.2					5.0	
実施例10	94.49					0.01				5.0	
実施例11	94.9					0.1				5.0	
実施例12	94.8					0.2				5.0	
実施例13	94.99						0.01			5.0	
実施例14	94.5						0.5			5.0	
実施例15	94.0							1.0		5.0	
実施例16	93.0							2.0		5.0	
実施例17	99.0							0.5		0.5	
実施例18	87.5									12.0	
実施例19	96.0		0.5								
実施例20	96.4			0.1							
実施例21	96.4				0.1						
実施例22	96.4					0.1					
実施例23	99.0						0.5			3.5	
実施例24	96.0						0.5			3.5	
実施例25	90.5						0.5			9.0	
実施例26	98.8		0.5								
実施例27	99.2			0.1							
実施例28	99.2				0.1						
実施例29	99.2					0.1					
実施例30	98.8						0.5			0.7	
実施例31	99.0						0.5			0.6	
実施例32	97.5						0.5			2.0	
比較例1	96.0									5.0	
比較例2	96.5										
比較例3	99.3										

[0028] About the solder furthermore shown in Table 1, the evaluation result of electrode-proof \*\*\*\*\* at the time soldering and soldering nature is shown in Table 2.

[0029]

[Table 2]

	半田付け後の電極面積残存率[%]		半田広がり率[%]	評価温度[°C]
	Cu電極	Ag電極		
実施例1	85.0	50.0	70	280
実施例2	98.0	60.0	71	280
実施例3	99.6	61.2	65	280
実施例4	77.0	38.0	70	280
実施例5	80.0	40.2	69	280
実施例6	81.0	41.0	63	280
実施例7	99.0	74.2	70	280
実施例8	99.5	80.1	66	280
実施例9	99.4	79.2	60	280
実施例10	86.0	60.2	70	280
実施例11	98.4	63.0	67	280
実施例12	99.0	65.3	62	280
実施例13	82.1	51.6	71	280
実施例14	95.4	63.5	70	280
実施例15	96.3	65.4	69	280
実施例16	97.1	67.8	63	280
実施例17	95.9	53.4	72	280
実施例18	84.1	51.8	78	300
実施例19	99.0	81.0	72	250
実施例20	95.4	76.8	69	250
実施例21	99.2	89.7	64	250
実施例22	99.2	85.0	66	250
実施例23	88.7	79.3	72	260
実施例24	99.7	84.6	72	250
実施例25	99.5	88.1	81	330
実施例26	99.7	52.0	71	260
実施例27	97.0	40.8	69	260
実施例28	99.5	68.9	65	260
実施例29	99.8	58.4	66	260
実施例30	99.6	53.2	72	260
実施例31	99.2	52.3	72	260
実施例32	99.5	50.1	78	330
比較例1	89.2	31.7	72	250
比較例2	7.0	0.0	70	280
比較例3	92.5	0.0	71	260

[0030] Here, the electrode-proof \*\*\*\*\* evaluation at the time of soldering measured by the electrostatic-capacity changing method. the veneer capacitor which carried out printing baking of Cu electrode (3 micrometers of thickness or the Ag electrode (20 micrometers of thickness) -- solder -- being immersed -- the difference of the electrostatic capacity before and behind being immersed -- the above to as opposed to [ take a value and ] the electrostatic capacit before being immersed -- difference -- the survival rate of an electrode was computed in quest of the value The soldering temperature which evaluated is shown in Table 2. For 10 seconds, since the capacity change after being immersed and Ag electrode were easy to be consumed, Cu electrode measured the capacity change after being immersed for 3 seconds.

[0031] In any case, in Cu electrode, the effect was [ the alloying element of this invention ] in electrode foods crack suppression as compared with the example of comparison. An electrode survival rate is 95% or more, and examples 3, examples 7-9, examples 11-12, examples 14-17, examples 19-22, and examples 24-32 showed electrode-proof \*\*\*\*\* with very good all. Moreover, in the examples 1-2 of comparison which are typical Pb free solder, an electrode survival rate is 90% or less, and the problem was looked at by electrode-proof \*\*\*\*\*.

[0032] Although examples 1, 4, 10, and 13 are 77 - 86% of electrode survival rates and are smaller than other examples, this is because there are few additions of an effective element. [ of electrode \*\*\*\*\* depressor effect ] Moreover, although an example 18 also has electrode \*\*\*\*\* depressor effect smaller than other examples, this is because soldering temperature is high. Moreover, although examples 5-6 also have the electrode-proof \*\*\*\*\* effec smaller than other examples, this is because the electrode \*\*\*\*\* depressor effect of Fe is smaller than other elemen

However, any composition is level usable according to soldering conditions.

[0033] Moreover, there were Cu and an analogous inclination also in Ag electrode, and when it was any, as compare with the example of comparison, the alloying element of this invention had an effect in electrode foods crack suppression.

[0034] About soldering nature, it evaluated using the rate of a solder breadth (based on JISZ3197). About examples 1 2, an example 4, an example 7, an example 10, examples 13-14, examples 17-19, examples 23-26, and examples 30- the rate of a solder breadth was all 70% or more, and it was very good soldering nature. Moreover, also about the

examples 1-3 of comparison, the rate of a solder breadth was all 70% or more, and it was very good soldering nature

[0035] Although the rate of a solder breadth is falling, this of an example 3, an example 6, an example 9, an example 12, and examples 15-16 is because liquid phase temperature rose since there were many additions of an effective element, and the fluidity of solder was checked. Moreover, although examples 8-9, examples 11-12, examples 21-22 and examples 28-29 show the rate of a solder breadth lower than other examples, this is for an effective element (Mn Cr) to tend to oxidize. However, any composition is level usable according to soldering conditions.

[0036] Moreover, although the rate of a solder breadth is high if the addition of Sb, Ag, and Cu is increased as shown an example 18, an example 25, and an example 32, the influence which raised soldering temperature with the rise of liquid phase temperature comes out of this.

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[Translation done.]

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CORRECTION or AMENDMENT

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[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law.

[Section partition] The 2nd partition of the 2nd section.

[Date of issue] September 11, Heisei 13 (2001. 9.11)

[Publication No.] JP,11-216591,A.

[Date of Publication] August 10, Heisei 11 (1999. 8.10)

[\*\*\*\* format] Open patent official report 11-2166.

[Filing Number] Japanese Patent Application No. 10-16142.

[The 7th edition of International Patent Classification]

B23K      35/26      310  
//C22C      13/00

[FI]

B23K      35/26      310 A  
C22C      13/00

[Procedure revision]

[Filing Date] December 12, Heisei 12 (2000. 12.12)

[Procedure amendment 1]

[Document to be Amended] Specification.

[Item(s) to be Amended] Whole sentence.

[Method of Amendment] Change.

[Proposed Amendment]

[Document Name] Specification.

[Title of the Invention] Solder and soldering goods.

[Claim(s)]

[Claim 1] At least one kind chosen from 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, and 0.5 - 2 % of the weight of Cu(s), Pb [ which contains 90.5 % of the weight or more of Sn, and is characterized by the bird clapper ] free solder.

[Claim 2] At least one kind chosen from 0.01 - 0.2 % of the weight of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0 - 2 % of the weight of Pd, at least one kind chosen from 0.5 - 9 % of the weight of Ag, and 0.5 - 5 % of the weight of Sb(s), and Pb [ which contains 90.5 % of the weight or more of Sn, and is characterized by the bird clapper ] free solder.

[Claim 3] They are the soldering goods which come to join the parts which have the changes metallic conductor which is easy to diffuse to fused Sn with solder.

The aforementioned solder is soldering goods characterized by using Pb free solder according to claim 1 or 2.

[Claim 4] The aforementioned changes metallic conductors are soldering goods according to claim 3 characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, Pt, and Zn, or those alloys.

[Detailed Description of the Invention]

[0001] [The technical field to which invention belongs] this invention relates to soldering goods at a solder row.

[0002]

[Description of the Prior Art] Before, solder is used in order to obtain electric and mechanical connection of electron equipment and electronic parts. The solder (it considers as Pb free solder hereafter.) with which this solder makes a principal component Sn which does not contain Pb in consideration of earth environment although what made Sn an Pb the principal component (it considers as Sn-Pb system solder below.) has generally been used, and the remainder consists of Ag, Bi, Cu, In, Sb, etc. is used increasingly.

[0003] By using this Pb free solder in recent years, the soldering goods with which soldering nature has a good elect joint have been manufactured.

[0004]

[Problem(s) to be Solved by the Invention] However, in the soldering goods using the solder whose Sn is a principal component, especially Pb free solder, when electrode \*\*\*\*\* happened at the time of soldering or elevated-temperat neglect and heat aging were performed, there was a trouble by diffusion of Sn that degradation of electric and a mechanical property took place.

[0005] The purpose of this invention is to provide with soldering goods Pb free solder row which neither electrode \*\*\*\*\* nor property degradation can produce easily, when the time of soldering or soldering post heating aging is performed.

[0006]

[Means for Solving the Problem] this invention came to complete soldering goods in Pb free solder row, in order to solve the above-mentioned technical problem. Pb free solder of invention of this application 1st contains at least one kind chosen from 0.01 - 1 % of the weight of Co(es), 0.01 - 0.2 % of the weight of Fe(s), 0.01 - 0.2 % of the weight o Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, and 0.5 - 2 % of the weight of Cu(s) and 90.5 % of the weight or more of Sn, and is characterized by the bird clapper.

[0007] Moreover, in Pb free solder of invention of this application 2nd, at least one kind of 0.01 - 0.2 % of the weigh of Mn, 0.01 - 0.2 % of the weight of Cr(s), and 0.01 - 2 % of the weight of Pd, at least one kind chosen from 0.5 - 9 % of the weight of Ag and 0.5 - 5 % of the weight of Sb(s), and 90.5 % of the weight or more of Sn are contained, and is characterized by the bird clapper.

[0008] moreover, the transition metals which are easy to diffuse to Sn which fused the soldering goods of this invent -- it is the soldering goods which come to join with solder the parts which have a conductor, and solder is characteriz by using Pb free solder of the above-mentioned 1st or the 2nd above-mentioned invention

[0009] Moreover, in the soldering goods of this invention, a changes metallic conductor is characterized by using at least one kind in the simple substances of Cu, Ag, nickel, Au, Pd, Pt, and Zn, or those alloys.

[0010]

[Embodiments of the Invention] The form of operation of this invention is explained below. Pb free solder of inventi of this application 1st is composition containing at least one kind chosen from Co, Fe, Mn, Cr, and Pd, and Cu and S Moreover, Pb free solder of invention of this application 2nd is composition containing at least one kind chosen from Mn, Cr, and Pd, at least one kind chosen from Ag and Sb, and Sn. and the transition metals which are easy to diffuse Sn which fused the soldering goods of this invention -- it is the soldering goods which come to join with solder the parts which have a conductor, and the 1st mentioned above or Pb free solder of the 2nd invention is used for solder Such composition enables it to offer the soldering goods which have sufficient electrode-proof \*\*\*\*\*\*, while soldering nature and a bonding strength are good.

[0011] That is, it is for Co, Fe, Mn, Cr, and Pd by which slight amount addition was carried out to form a segregation layer in the junction interface of a conductor and solder, to prevent diffusion into the melting solder of a conductor, a to prevent electrode \*\*\*\*\*.

[0012] The addition of Above Co was made into 0.01 - 1 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Co is less than 0.01 % of the weight. It is because liquid line temperature rises and a melting property is checked on the other hand, when the addition of Co exceeds 1 % of t weight. In addition, more desirable Co addition is 0.01 - 0.5% of the weight of a range, and its time of especially Co addition being 0.5 % of the weight is desirable.

[0013] The addition of Above Fe was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Fe is less than 0.01 % of the weight. It is because liquido

line temperature rises and a melting property is checked on the other hand, when the addition of Fe exceeds 0.2 % of the weight. In addition, more desirable Fe addition is 0.01 - 0.1% of the weight of a range, and its time of especially addition being 0.1 % of the weight is desirable.

[0014] The addition of Above Mn was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole because electrode-proof \*\*\*\*\* deteriorated when the addition of Mn is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Mn exceed 0.2 % of the weight. In addition, more desirable Mn addition is 0.01 - 0.1% of the weight of a range, and its time of especially Mn addition being 0.1 % of the weight is desirable.

[0015] The addition of Above Cr was made into 0.01 - 0.2 % of the weight in 100 % of the weight of whole weights because electrode-proof \*\*\*\*\* deteriorated when the addition of Cr is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Cr exceeds 0.2 % of the weight. In addition, more desirable Cr addition is 0.01 - 0.1% of the weight of a range, and its time of especially Cr addition being 0.1 % of the weight is desirable.

[0016] The addition of Above Pd was made into 0.01 - 2 % of the weight in 100 % of the weight of whole weights because electrode-proof \*\*\*\*\* deteriorated when the addition of Pd is less than 0.01 % of the weight. It is because liquidus-line temperature rises and a melting property is checked on the other hand, when the addition of Pd exceeds % of the weight. In addition, more desirable Pd addition is 0.01 - 1% of the weight of a range, and its time of especia Pd addition being 0.5 % of the weight is desirable.

[0017] The addition of Above Ag was carried out among [ 0.5-9 ] 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Ag is less than 0.5 % of the weight. It is because the bonding-strength fall by a superfluous Ag<sub>3</sub>Sn intermetallic compound depositing and the melting property by solder liquidus-line temperature rising are checked on the other hand when the addition of Ag exceeds 9 % of the weight.

[0018] The addition of Above Cu was made into 0.5 - 2 % of the weight in 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Cu is less than 0.5 % of the weight. is because the bonding-strength fall by superfluous Cu<sub>6</sub>Sn<sub>5</sub> and a Cu<sub>3</sub>Sn intermetallic compound depositing and the melting property by solder liquidus-line temperature rising are checked on the other hand when the addition of Cu exceeds 2 % of the weight.

[0019] The addition of Above Sb was made into 0.5 - 5 % of the weight in 100 % of the weight of whole weights because the on-the-strength improvement effect was small when the addition of Sb is less than 0.5 % of the weight. I because thermal shock nature and processability are checked on the other hand when elongation falls, when the addition of Sb exceeds 5 % of the weight.

[0020] the transition metals which are easy to diffuse to fused Sn as used in the field of this invention -- as composit of a conductor, the simple substance of Cu, Ag, nickel, Au, Pd, Pt, and Zn etc. is typical In addition, the alloy of thes transition metals, for example, Ag/Pd, Ag/Pt, etc. are sufficient. They are the simple substance of Cu, Ag, and nickel its alloy more preferably. Electrode \*\*\*\*\* suppression is attained maintaining soldering nature and a bonding strength, even if it uses for the goods which have such a conductor that is easy to carry out electrode \*\*\*\*\*.

[0021] Although a glass frit and various additives (metallic oxide etc.) are added by the above-mentioned changes metallic conductor if needed, if the metal composition which is electric conduction components is the above composition, of course, the same effect is acquired. Moreover, the same effect is acquired when low melting point metals, such as Bi and In, are added as solder composition in order to lower a working temperature.

[0022] Here, in this invention, an unescapable impurity may be included as solder composition in addition to the abo mentioned component. The element mixed as an unescapable impurity when manufacturing solder or the element containing from the first, for example, Pb, Bi, Cu, Na, etc., is mentioned.

[0023] After the soldering goods of this invention process Pb free solder made to dissolve the above-mentioned addition component in Sn of a principal component in the shape of a ball, carry a solder ball on parts or a substrate a apply flux, they can be easily created by heating to temperature predetermined in the inside of the atmosphere, and joining the conductor of parts.

[0024] In addition, although generally soldered in many cases in N<sub>2</sub> atmosphere a sake [ on a soldering disposition ] is possible to solder in the atmosphere in this invention, since there are few additions of Co, Fe, Mn, Cr, and Pd.

[0025] the parts itself to which the soldering goods of this invention are joined, and the conductor of parts, although whole including the soldered joint section which joined comrades electrically and mechanically is meant and there ar various forms For example, electric in the conductor formed in the element-placement substrate, and the conductor

formed in parts The thing made to solder in order to make it connect mechanically, the thing made to solder in order to connect an electronic-parts element and a terminal electrically and mechanically, the thing made to solder in order to connect the electrodes of an electronic-parts element electrically and mechanically are typical.

[0026] As the above-mentioned element-placement substrate, ceramic substrates, such as a printed circuit board mad from glass epoxy, a printed circuit board made from a phenol, and an alumina, the substrate which has insulator laye such as a ceramic, on a metaled front face are mentioned, for example. furthermore, the above -- as a conductor, wiri circuits, such as a printed circuit board, the terminal electrode of electronic parts, a lead terminal, etc. are mentioned

[0027] Thus, soldering goods have soldering nature and a good bonding strength, and since they have outstanding electrode-proof \*\*\*\*\* in Pb free solder row of the produced this invention, can set up soldering temperature free in it, and become the thing excellent in workability at it. Moreover, it becomes possible to lessen the addition of expensive electrode \*\*\*\*\* suppression elements, such as Ag. Next, although this invention is explained still more concretely based on an example, this invention is not limited only to this example.

[0028]

[Example] The solder composition used by this example is shown in Table 1. In addition, composition of the exampl of comparison is also collectively shown in Table 1.

[0029]

[Table 1]

[重量%]

b	Co	F	Mn	Cr	Pd	Ag	Cu	Sb
			0.01					5.00
			0.10					5.00
			0.20					5.00
				0.01				5.00
				0.10				5.00
				0.20				5.00
					0.01			5.00
					0.05			5.00
					1.00			5.00
					2.00			5.00
					0.50			0.50
					0.10			3.50
					0.10			3.50
						0.50		0.50
						0.50		0.50
						0.50		0.50
						0.50		0.50
						0.10		0.10
							0.70	0.70
							0.70	0.70
							0.70	0.70
								2.00
								5.00
								3.50

[0030] About Pb free solder furthermore shown in Table 1, the evaluation result of electrode-proof \*\*\*\*\* at the time of soldering and soldering nature is shown in Table 2.

[0031]

[Table 2]

	半田付け後の電極面積残存率 [%]		半田広がり率 [%]	評価温度 [°C]	
	Cu電極	Ag電極			
実施例	1	99.0	74.2	70	28
	2	99.5	80.1	66	28
	3	99.4	79.2	60	28
	4	86.0	60.2	70	28
	5	98.4	63.0	67	28
	6	99.0	65.3	62	28
	7	82.1	51.6	71	28
	8	95.4	63.5	70	28
	9	96.3	65.4	69	28
	10	97.1	67.8	63	28
	11	95.9	53.4	72	28
	12	99.2	89.7	64	25
	13	99.2	85.0	66	25
	14	88.7	79.3	72	26
	15	99.7	84.6	72	25
	16	99.5	88.1	81	33
	17	99.7	52.0	71	26
	18	97.0	40.8	69	26
	19	99.5	68.9	65	26
	20	99.8	58.4	66	26
	21	99.6	53.2	72	26
	22	99.2	52.3	72	26
	23	99.5	50.1	78	33
比較例	1	7.0	0.0	70	28
	2	89.2	31.7	72	25
	3	92.5	0.0	71	26

[0032] Here, the electrode-proof \*\*\*\*\* evaluation at the time of soldering measured by the electrostatic-capacity changing method. the veneer capacitor which carried out printing baking of Cu electrode (3 micrometers of thickness or the Ag electrode (20 micrometers of thickness) -- solder -- being immersed -- the difference of the electrostatic capacity before and behind being immersed -- the above to as opposed to [ take a value and ] the electrostatic capacit

before being immersed -- difference -- the survival rate of an electrode was computed in quest of the value The soldering temperature which evaluated is shown in Table 2. For 10 seconds, since the capacity change after being immersed and Ag electrode were easy to be consumed, Cu electrode measured the capacity change after being immersed for 3 seconds.

[0033] In any case, in Cu electrode, the effect was [ the alloying element of this invention ] in electrode foods crack suppression as compared with the example of comparison. An electrode survival rate is 95% or more, and examples 3, examples 5-6, examples 8-11, examples 12-13, and examples 15-23 showed electrode-proof \*\*\*\*\* with very good all. Moreover, in the examples 1-2 of comparison which are typical Pb free solder, an electrode survival rate is 90% or less, and the problem was looked at by electrode-proof \*\*\*\*\*.

[0034] Although examples 4 and 7 are 77 - 86% of electrode survival rates and are smaller than other examples, this because there are few additions of an effective element. [ of electrode \*\*\*\*\* depressor effect ] However, any composition is level usable according to soldering conditions.

[0035] Moreover, there were Cu and an analogous inclination also in Ag electrode, and when it was any, as compare with the example of comparison, the alloying element of this invention had an effect in electrode foods crack suppression.

[0036] About soldering nature, it evaluated using the rate of a solder breadth (based on JISZ3197). About an example 1, an example 4, examples 7-8, an example 11, examples 14-17, and examples 21-23, the rate of a solder breadth wa all 70% or more, and it was very good soldering nature. Moreover, also about the examples 1-3 of comparison, the ra of a solder breadth was all 70% or more, and it was very good soldering nature.

[0037] Although the rate of a solder breadth is falling, this of an example 3, an example 6, and examples 9-10 is because liquid phase temperature rose since there were many additions of an effective element, and the fluidity of solder was checked. Moreover, although examples 2-3, examples 5-6, examples 12-13, and examples 19-20 show th rate of a solder breadth lower than other examples, this is for an effective element (Mn, Cr) to tend to oxidize. However, any composition is level usable according to soldering conditions.

[0038] Moreover, although the rate of a solder breadth is high if the addition of Sb, Ag, and Cu is increased as shown an example 16 and an example 23, the influence which raised soldering temperature with the rise of liquid phase temperature comes out of this.

[0039]

[Effect of the Invention] Thus, if the soldering goods of this invention are used, while soldering nature is good in the soldered joint section, it is possible to have outstanding electrode-proof \*\*\*\*\*. Moreover, this electrode-proof \*\*\*\*\* cannot remain in electrode \*\*\*\*\* at the time of soldering, but can be suppressed also about electrode \*\*\*\*\* at the time of elevated-temperature neglect of the soldering goods after soldering.

[0040] Moreover, since electrode \*\*\*\*\* which has been a technical problem with Pb free solder can be suppressed, free-ization of solder becomes more practical and it becomes possible to offer an eco-friendly product.

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[Translation done.]